

Detector R&D for an Electron Ion Collider

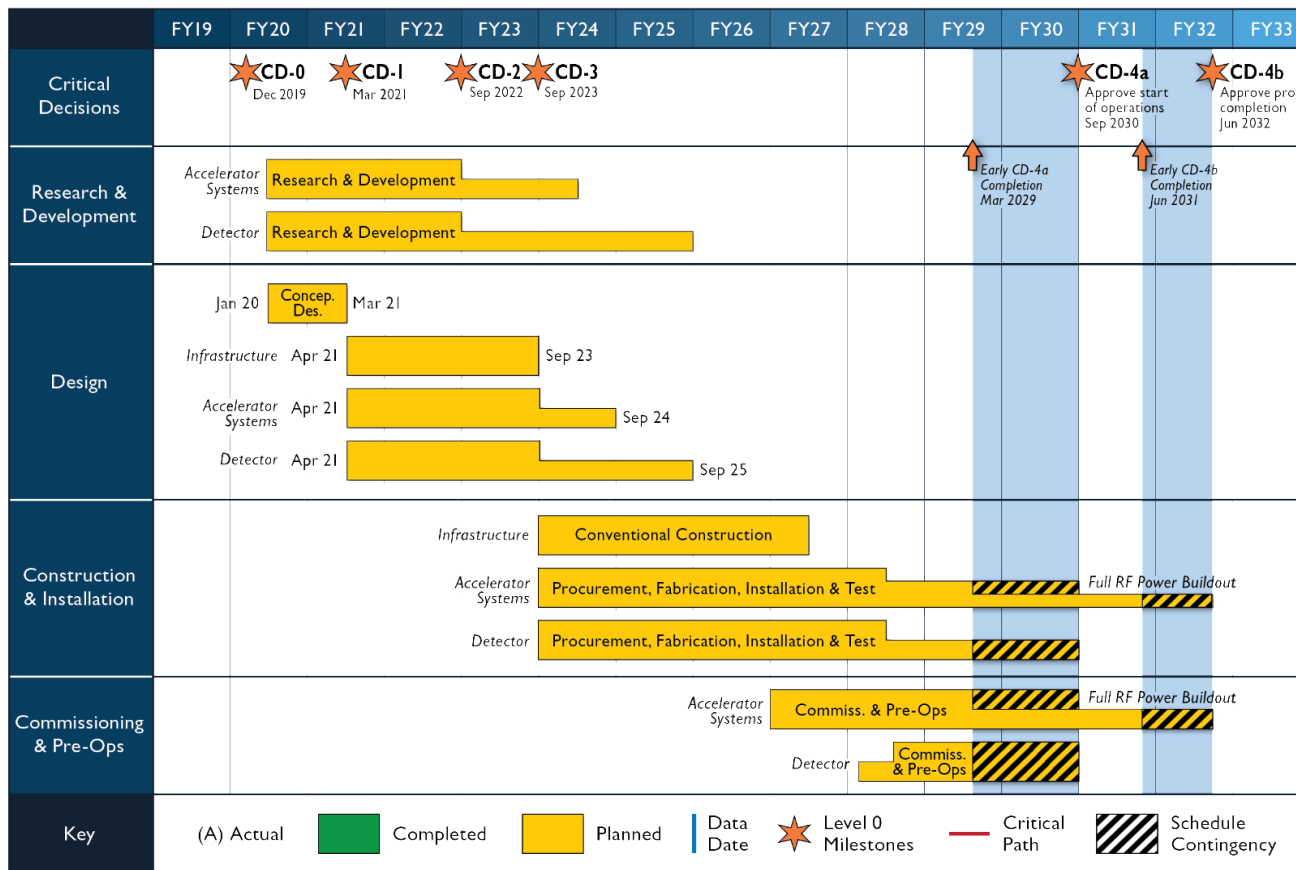
19th Advisory Committee Meeting
BNL, July 23/24/27, 2020

Thomas Ullrich (BNL/Yale)
January 30, 2020



EIC Status - Project

- EIC Project structure pretty much defined
- Project separate from BNL NPP department, JLab integrated
- Aggressive time schedule



Project Detector Systems:
A. Aschenauer (BNL) and R. Ent (JLab)

EIC Status - User Group

- Yellow Report initiative in full swing. Good progress on both sides
 - physics requirements
 - detector concepts
- Many of the detector WG are driven by participants in the EIC detector R&D program
- Requirements tabulated in interactive detector matrix, see <https://physdiv.jlab.org/DetectorMatrix/>

η	Nomenclature		Tracking			Electrons		$\pi/K/p$		HCAL	Muons
			Resolution	Allowed X/X ₀	Si-Vertex	Resolution $\sigma\theta/E$	PID	p-Range (GeV/c)	Separation	Resolution $\sigma\theta/E$	
-6.9 to -5.8	↓ p/A	Auxiliary Detectors	low-Q ₂ tagger	$\sigma\theta/\theta < 1.5\% \cdot 10^{-6}$ $< Q_2 < 10^{-2} \text{ GeV}^2$							
...											
-4.5 to -4.0			Instrumentation to separate charged particles from photons								
-4.0 to -3.5						2%/√E					
-3.5 to -3.0	Central Detector	Backward Detector	$\sigma_{p/p} \approx 0.1\% \oplus 0.5\%$		TBD						
-3.0 to -2.5			$\sigma_{p/p} 0.1\% \oplus 0.5\%$			2%/√E		≤ 7 GeV/c		-50%/√E	
-2.5 to -2.0			$\sigma_{p/p} 0.05\% \oplus 0.5\%$			7%/√E					
-2.0 to -1.5						7%/√E					
-1.5 to -1.0		Barrel			$\sigma_{xyz} \approx 20 \mu\text{m}$ $d\phi(z) - d\phi(r\phi) \approx 20/p_T \text{ GeV} \mu\text{m} \approx 5 \mu\text{m}$						
-1.0 to -0.5			$\sigma_{p/p} \approx 0.05\% \oplus 0.5\%$	-5% or less X							
-0.5 to 0.0								≤ 5 GeV/c	≈ 3 σ		TBD
0.0 to 0.5											
0.5 to 1.0		Forward Detectors			TBD						
1.0 to 1.5			$\sigma_{p/p} \approx 0.05\% \oplus 1.0\%$					≤ 8 GeV/c			
1.5 to 2.0											
2.0 to 2.5								≤ 20 GeV/c		-50%/√E	
2.5 to 3.0			$\sigma_{p/p} \approx 0.1\% \oplus 2.0\%$								
3.0 to 3.5								≤ 45 GeV/c			
3.5 to 4.0	↑ e	Auxiliary Detectors	Instrumentation to separate charged particles from photons								
4.0 to 4.5											
...			Neutron Detection								
> 6.2			Proton Spectrometer	$\sigma_{\text{intrinsic}} \theta / \theta < 1\%$; Acceptance: $0.2 < p_T < 1.2 \text{ GeV/c}$							

work in progress

EIC Status - Future of R&D (I)

- On request, submitted White Paper on R&D to DOE
 - ▶ Well received by DOE
 - ⦿ EIC Project-related detector R&D
 - ⦿ Generic EIC-related detector R&D
 - ⦿ Considerations for a Nuclear Physics Detector R&D Program
- Detector Advisory Committee (DAC)
 - ▶ DAC Charter, Membership, and White Paper on Detector R&D under discussion with DOE ONP
 - ▶ New international DAC will be assembled. Overlap with current to ensure continuation.
- Everyone involved is committed to avoid gaps in R&D support and funding

EIC R&D Advisory Committee

Standing Advisory Committee:

Marcel Demarteau* (ORNL)

Carl Haber (LBNL)

Peter Krizan (Ljubljana)

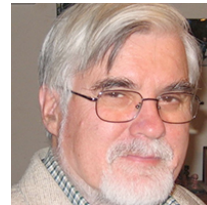
Ian Shipsey (Purdue)

Rick Van Berg (UPenn)

Jerry Va'vra (SLAC)

Glenn Young (JLab)

*chair



Thanks to COVID-19, there's no opportunity for informal discussion with committee members during breaks. Use the discussion session after the talks and especially speak up at the close-out.

FY2020 Funding Period (Status Reports)

- 11 (10) Projects are funded in FY20
 - ▶ eRD1 - Calorimeter consortium
 - ▶ eRD6 - Tracking consortium
 - ▶ eRD14 - PID consortium
 - ▶ ~~eRD16 - Fwd Silicon tracking~~
 - ▶ eRD17 - Simulations/BEAGLE
 - ▶ ~~eRD18 - Central Si tracking~~
 - ▶ eRD20 - Software consortium
 - ▶ eRD21 - Machine background studies
 - ▶ eRD22 - GEM TRD
 - ▶ eRD23 - Streaming Readout
 - ▶ eRD24 - Roman Pots
 - ▶ eRD25 - [eRD16+eRD18]

FY2021 Funding Period (Proposals)

- 9 existing projects submitted proposals
 - ▶ eRD1 - Calorimeter consortium
 - ▶ eRD6 - Tracking consortium
 - ▶ eRD14 - PID consortium
 - ▶ eRD17 - Simulations/BEAGLE
 - ▶ eRD21 - Machine background studies
 - ▶ eRD22 - GEM TRD
 - ▶ eRD23 - Streaming Readout
 - ▶ eRD24 - Roman Pots
 - ▶ eRD25 - [eRD16+eRD18]
- 4 new proposals
 - ▶ Pulsed laser system for Compton polarimetry at the future EIC facility
 - ▶ Developing a High Resolution ZDC for the EIC
 - ▶ Superconducting Nanowire Detectors
 - ▶ Precision Timing Silicon Detectors for a Combined PID and Tracking System at EIC

Logistics

- As for every remote meeting
 - ▶ **Mute** when you are not speaking
 - ▶ When you want to ask a question or comment and you are not on the Committee and not the speaker, please "raise you hand"
 - ⦿ Go to "People", "Raise hand" button is on the bottom
- Send talks to me 1 day in advance
- There will be no dedicated homework sessions. If the Committee has questions I will let you know. Please send the answers to me.

Thursday, July 23, 2020

Time	Title	Speaker (Time)	Slides
10:15	Committee: Executive Session		
11:00	Welcome and Overview	Thomas Ullrich (10)	-
11:10	eRD6/Tracking: Progress Report and Proposal	Kondo Gnanvo, Bob Azmoun, Silvia Dalla Torre (40+15)	-
12:05	eRD22/GEM-TRD: Progress Report and Proposal	Yulia Furletova (20+10)	-
12:35	Break		
12:50	eRD25/Si: Progress Report and Proposal	Laura Gonella (40+15)	pdf
13:45	eRD14/DIRC: Progress Report and Proposal	Jochen Schwienig (12+3)	-
14:00	eRD14/mRICH: Progress Report and Proposal	Xiaochun He (12+3)	-
14:15	eRD14/dRICH: Progress Report and Proposal	Marco Contalbrigo (12+3)	-
14:30	eRD14/Electronics & Sensors: Progress Report and Proposal	Gary Varner (12+3)	-
14:45	Committee: Executive Session		

Friday, July 24, 2020

Time	Title	Speaker (Time)	Slides
10:00	eRD24/Roman Pots: Progress Report and Proposal	TBD (20+10)	-
10:30	eRD17/BeAGLE: Progress Report and Proposal	Mark Baker (20+10)	-
11:00	eRD23/Streaming Readout: Progress Report and Proposal	Jan Bernauer (20+10)	-
11:30	Break		
11:45	eRD21/Background Studies: Progress Report and Proposal	TBD (20+10)	-
12:15	eRD1/Calorimetry: Progress Report and Proposal	Craig Woody, Tanja Horn, Huan Huang (40+15)	-
13:10	Committee: Executive Session		

Monday, July 27, 2020

Time	Title	Speaker (Time)	Slides
10:00	eRD20/Software: Progress Report	Markus Diefenthaler (20+10)	-
10:30	NEW/ZDC: Proposal	Michael Murray (20+10)	-
11:00	NEW/Polarimetry-Laser: Proposal	Ciprian Gal (20+10)	-
11:30	Break		
11:45	NEW/ToF-LGAD: Proposal	Wei Li (20+10)	-
12:15	NEW/Nanowires: Proposal	TBD (20+15)	-
12:45	Committee: Executive Session		
14:45	Close-Out		